CLAIMS

We claim:

1. A device for detecting biomolecules, comprising:

a detection surface electronically coupled to an electronic circuit;

a molecular layer directly or indirectly immobilized on the detection surface, the molecular layer comprising a mixture of an affinity binding molecule and a spacer molecule; and

a signal molecule in a containment area, the signal molecule comprising a recognition head and an electrically charged tail, wherein the recognition head of the signal molecule specifically binds to the affinity binding molecule, and the electronic circuit is configured to determine the presence of the signal molecule specifically bound by the affinity binding molecule immobilized on the detection surface.

2. The device of claim 1 wherein the signal molecule is produced from a signal probe, the signal probe comprising a recognition component and a signal template component, wherein the recognition component specifically binds, either directly or indirectly, a target to be detected, and the signal template component codes for the signal molecule.

3. The device of claim 2, wherein the recognition component comprises a biomolecule and the signal template component comprises a DNA template.

4. The device of claim 3, wherein the biomolecule binds directly to the target and the signal molecule is produced through *in vitro* transcription of the DNA template linked to the biomolecule.

5. The device of claim 3, wherein the biomolecule binds indirectly to the target and the signal molecule is produced through *in vitro* transcription of the DNA template linked to the biomolecule.

6. The device of claim 3, wherein the biomolecule binds to the target and the signal molecule comprises a peptide produced through *in vitro* transcription and translation of the DNA template.

7. The device of claim 1, wherein the detection surface comprises a conductor.

8. The device of claim 7, wherein the conductor comprises a metal.

9. The device of claim 8, wherein the metal comprises gold, copper, aluminum, tin, platinum, or silver.

10. The device of claim 1, wherein the detection surface comprises a semiconductor material.

11. The device of claim 10, wherein the semiconductor comprises, silicon, silicon dioxide, or polysilicon.

12. The device of claim 1, wherein the affinity binding molecule is directly or indirectly immobilized on the detection surface.

13. The device of claim 1, wherein the affinity binding molecule is an organic molecule or a biomolecule.

14. The device of claim 1, wherein the affinity binding molecule comprises an RNA aptamer.

15. The device of claim 1, wherein the affinity binding molecule comprises a protein.

16. The device of claim 15, wherein the affinity binding molecule comprises an antibody.

17. The device of claim 15, wherein the affinity binding molecule comprises a metalloporphyrin.

18. The device of claim 17, wherein the metalloprotein is hemin.

19. The device of claim 1, wherein the affinity binding molecule comprises a polyelectrolyte material.

20. The device of claim 19, wherein the polyelectrolyte comprises chitosan, polylysine, alginate, or a polyphosphate.

21. The device of claim 1, wherein the affinity binding molecule comprises a nucleic acid.

22. The device of claim 21, wherein the nucleic acid comprises thymine, uracil, poly-T, poly-U, poly-A, poly-G, poly-C or other polynucleic acids.

23. The device of claim 18, wherein the metalloprotein is hemin and the signal molecule interacts with the hemin to enhance enzymatic activity and amplify the signal via the enhanced enzymatic activity.

24. The device of claim 1, wherein the spacer molecule is directly immobilized on the detection surface.

25. The device of claim 1, wherein the spacer molecules comprises a small organic molecule or an organic polymer.

26. The device of claim 25, wherein the small organic molecule comprises a mercaptoalcohol.

27. The device of claim 26, wherein the mercaptoalcohol comprises mercaptohexanol.

28. The device according to claim 25, wherein the organic polymer comprises polyethylene glycol.

29. The device of claim 1, wherein the signal molecule comprises an RNA transcript.

30. The device of claim 1, wherein the signal molecule comprises a tag peptide.

31. The device of claim 1, wherein the signal molecule comprises a biotinylated antigen.

32. The device of claim 1, wherein the signal molecule comprises an RNA aptamer head that specifically binds to the affinity binding molecule.

33. The device of claim 1, wherein the electrically charged tail of the signal molecule comprises a polynucleic acid or a polypeptide.

34. The device of claim 33, wherein the electrically charged tail comprises a poly-A tail.

35. The device of claim 3, wherein the DNA template codes for a signal molecule, wherein the signal molecule comprises an RNA aptamer recognition head and an electrically charged poly-A tail.

36. The device of claim 3, wherein the DNA template codes for a signal molecule, wherein the signal molecule comprises a tag peptide.

37. The device of claim 2, wherein the DNA molecule template can be directly or indirectly linked to a biomolecule.

38. The device of claim 2, wherein the recognition component of the signal probe comprises an antibody.

39. The device of claim 2, wherein the recognition component of the signal probe comprises an antigen.

40. The device of claim 2, wherein the recognition component of the signal probe comprises an enzyme interactive with a substrate.

41. The device of claim 2, wherein the recognition component of the signal probe comprises a nucleic acid.

42. The device of claim 2, wherein the recognition component of the signal probe comprises a protein.

43. The device of claim 2, wherein the recognition component of the signal probe comprises a polypeptide.

44. The device of claim 2, wherein the recognition component of the signal probe comprises a substrate that specifically binds a polypeptide.

45. The device of claim 2, wherein the recognition component of the signal probe comprises a receptor that specifically binds a ligand.

46. The device of claim 2, wherein the recognition component of the signal probe comprises a ligand that specifically binds a receptor.

47. The device of claim 1, wherein the detection surface is electronically coupled directly or indirectly to a gate of a transistor, the transistor driving electronics to produce qualitative or quantitative data.

48. The device of claim 1, wherein the electronic circuit comprises a plurality of n-MOS and p-MOS devices.

49. The device of claim 1, wherein the electronic circuit further comprises:

a conductor path with a first end electronically coupled to the detector surface;

a polysilicon gate of a field effects transistor (FET) electronically coupled to a second end of the conductor path;

amplifier electronics electrically coupled to the FET; and

digital analysis circuitry electrically coupled to the amplifier electronics.

50. The device according to claim 49, wherein the digital analysis circuitry is configured to perform at least accounting, ratio, summation, and threshold operations, and combinations thereof.

51. The device of claim 49, wherein an initial bias charge of the polysilicon gate is above a threshold charge for a MOSFET transistor such as an n-MOS FET or a p-MOS FET.

52. The device of claim 1, wherein the detector surface is electrically connected to an n-MOS FET.

53. The device of claim 1, wherein the detector surface is electrically connected to a p-MOS FET.

54. The device of claim 49, wherein the transistor comprises an ultra low power transistor with low threshold voltage near or even zero volts.

55. The device of claim 49, wherein a reference voltage is provided to the circuit.

56. The device of claim 1, wherein the containment area is coupled to a reaction vessel.

57. The device of claim 1, wherein the containment area also serves as a reaction vessel.

58. The device of claim 56, wherein the containment area and the reaction vessel are coupled through a microchannel.

59. A method for detecting a target in a sample, comprising:

immobilizing the target in a reaction vessel;

contacting the target with a signal probe, wherein the signal probe comprises a recognition component and a signal template component, wherein the recognition component specifically binds

directly or indirectly to the target and the signal template component codes for a signal molecule, wherein the signal molecule comprises a recognition head and an electrically charged tail;

producing the signal molecule using the signal template component coding for the signal molecule; and

detecting the signal molecule at a detection surface, wherein the detection surface comprises an affinity binding molecule and a spacer molecule, wherein the recognition head of the signal molecule specifically binds to the affinity binding molecule and the electrically charged tail of the signal molecule brings a charge to the detection surface that is detected and indicates the presence of the target in the sample.

60. The method of claim 59, further comprising removing any signal probe that is not specifically bound to the target immobilized in the reaction vessel.

61. A method of detecting biological substances, comprising:

interacting a biological sample with a plurality of transistors in a circuit, each transistor having a gate, the circuit including an electrical signal; and

modifying electrical properties of the circuit in response to a biological substance in contact with at least one gate.